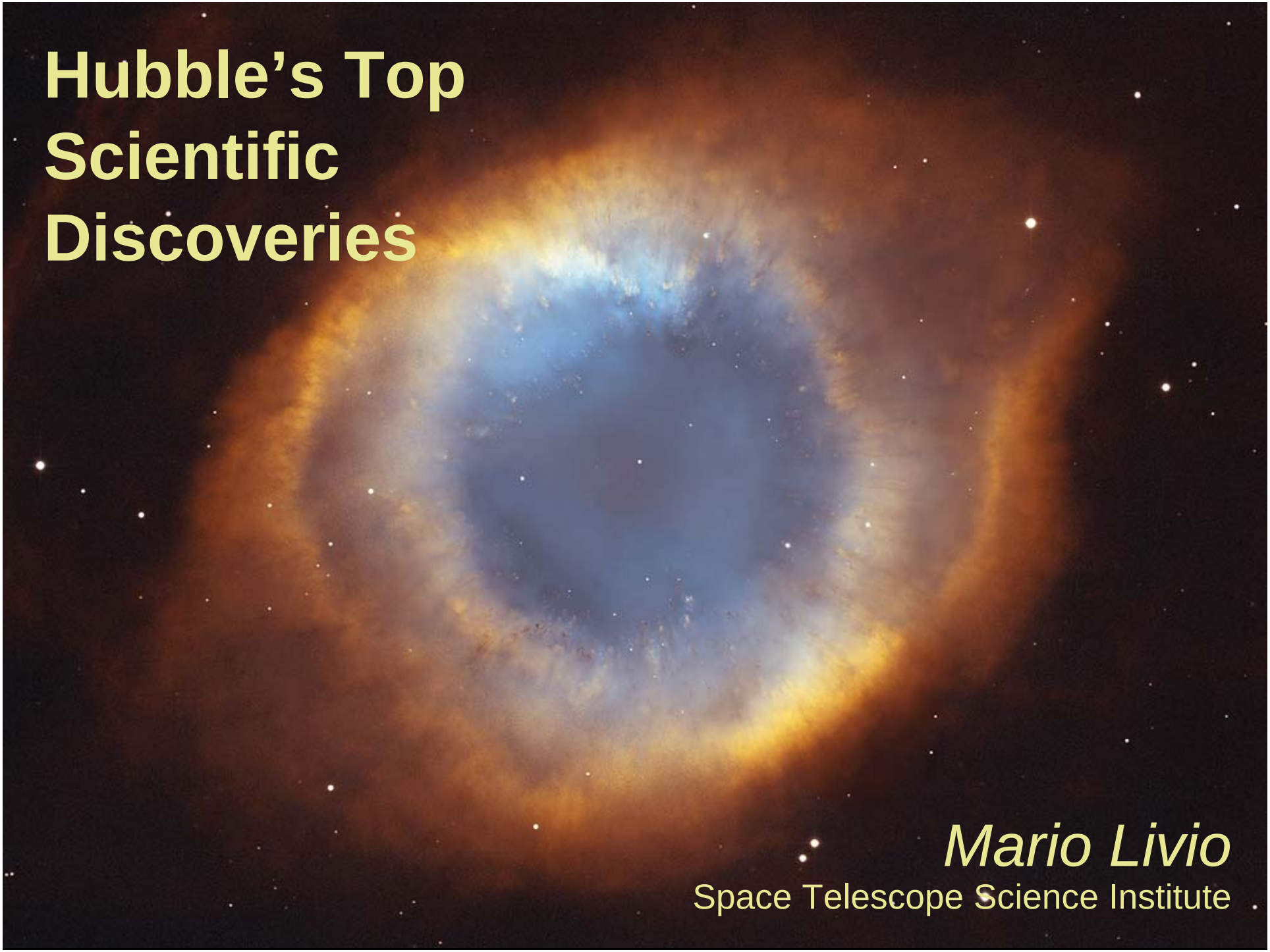
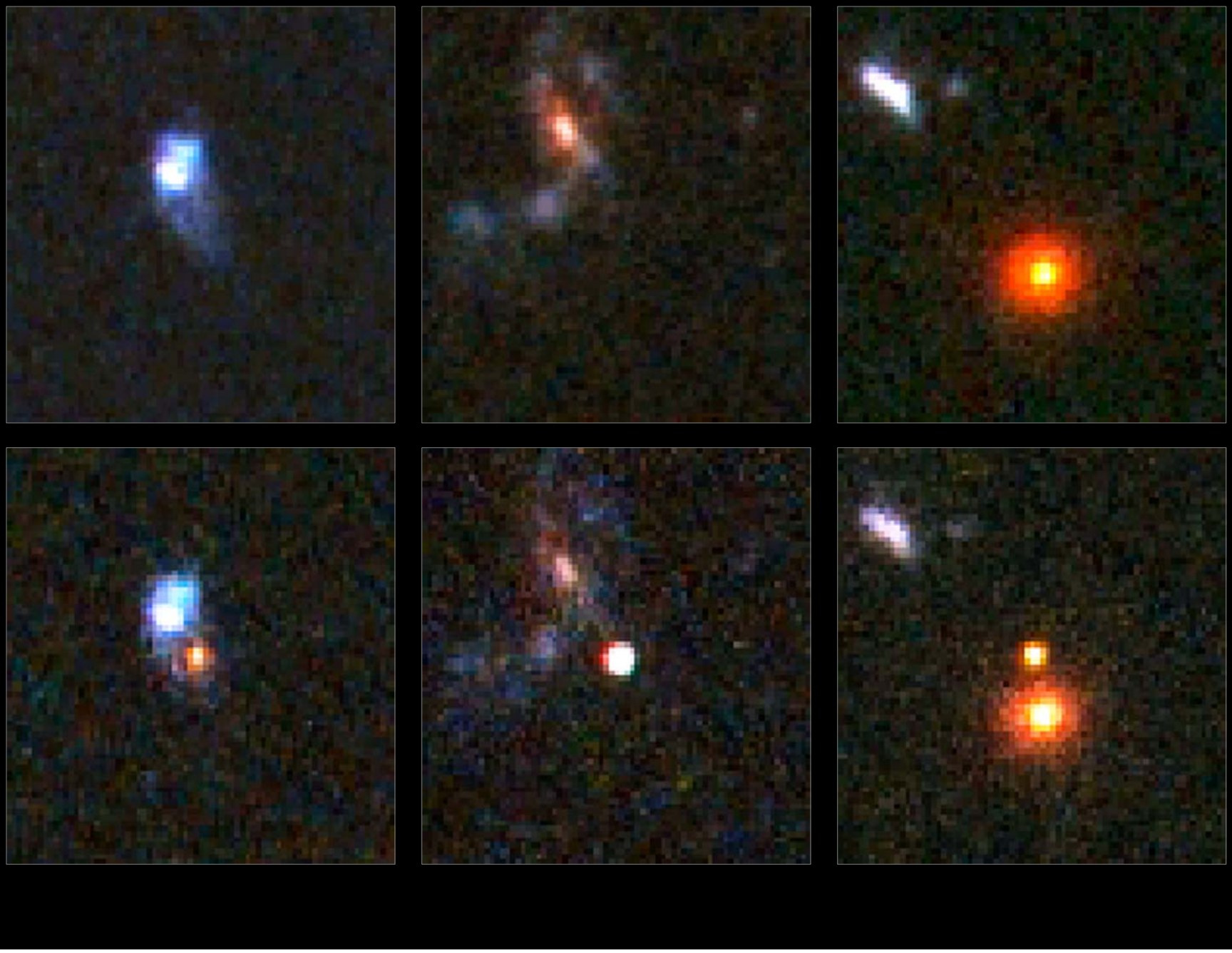
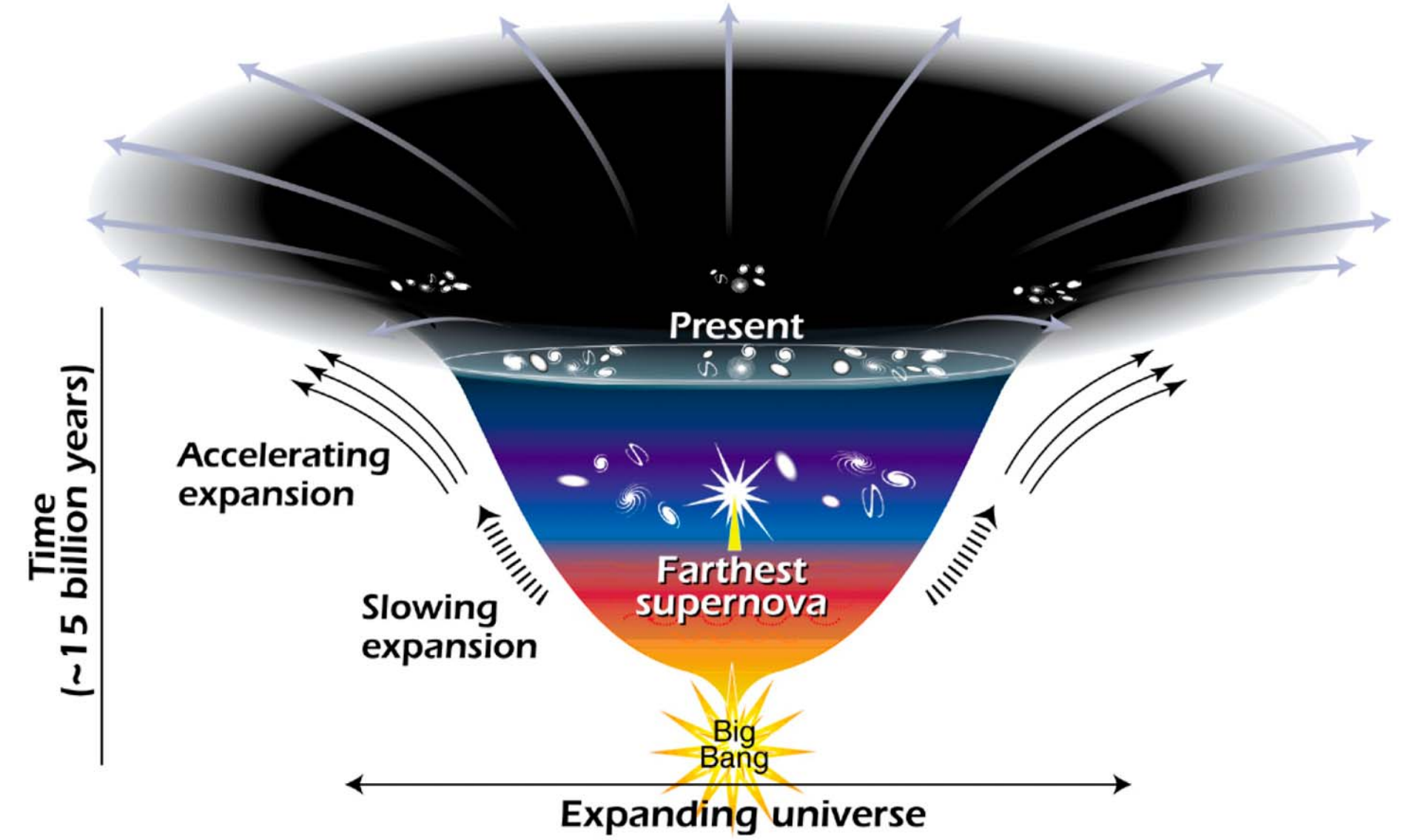


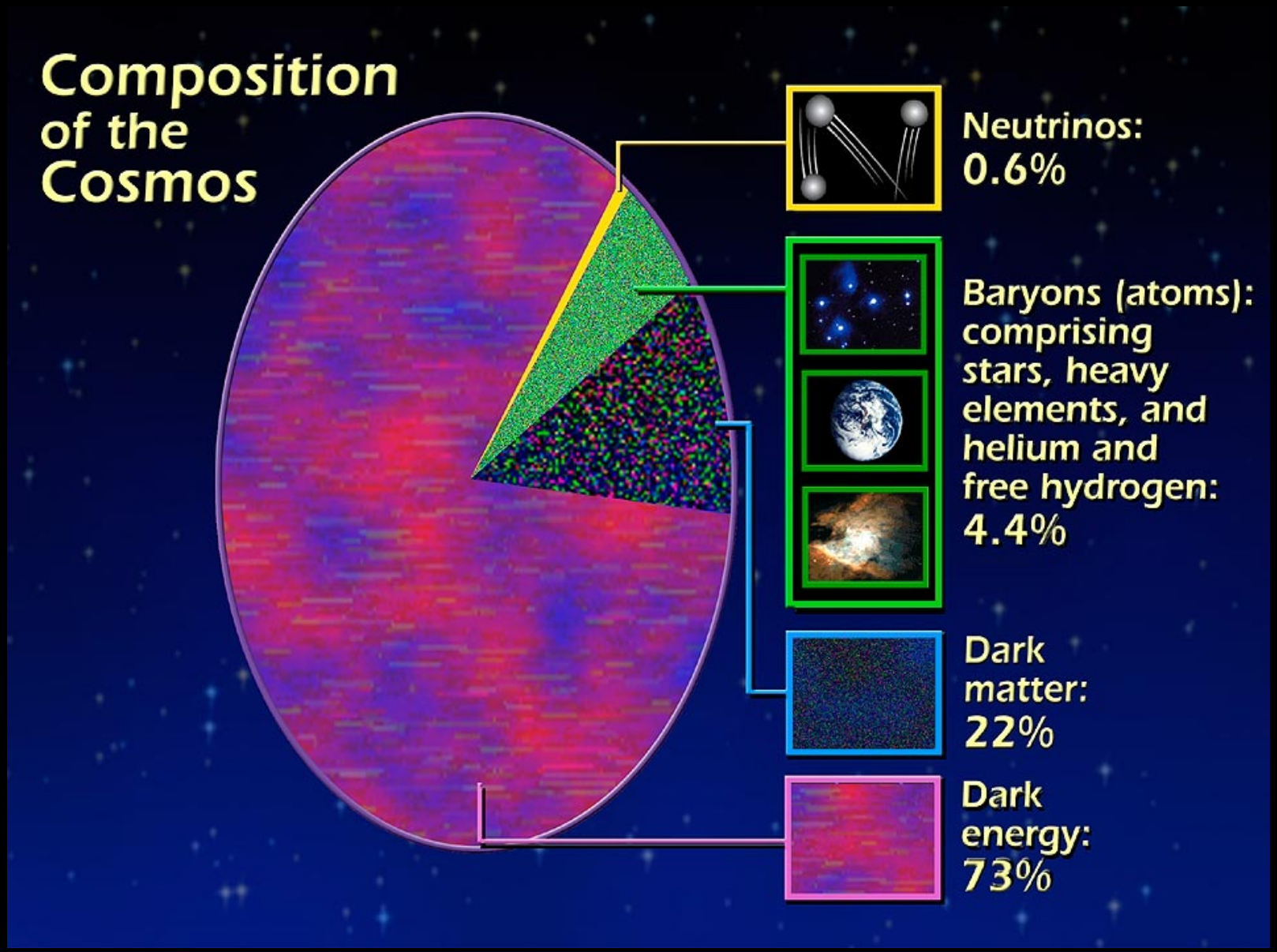
Hubble's Top Scientific Discoveries

Mario Livio
Space Telescope Science Institute

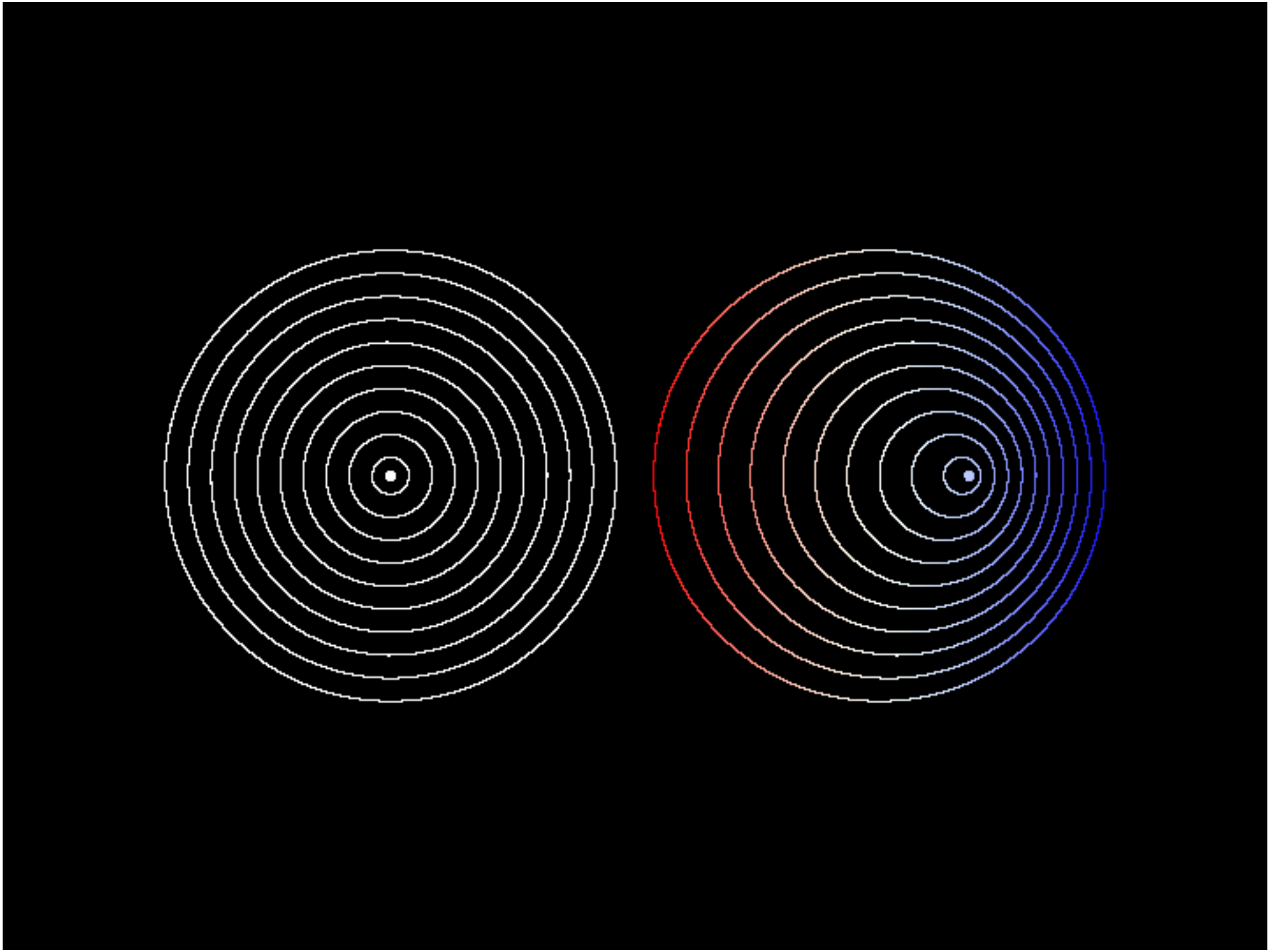
1: The Accelerating Universe and Dark Energy



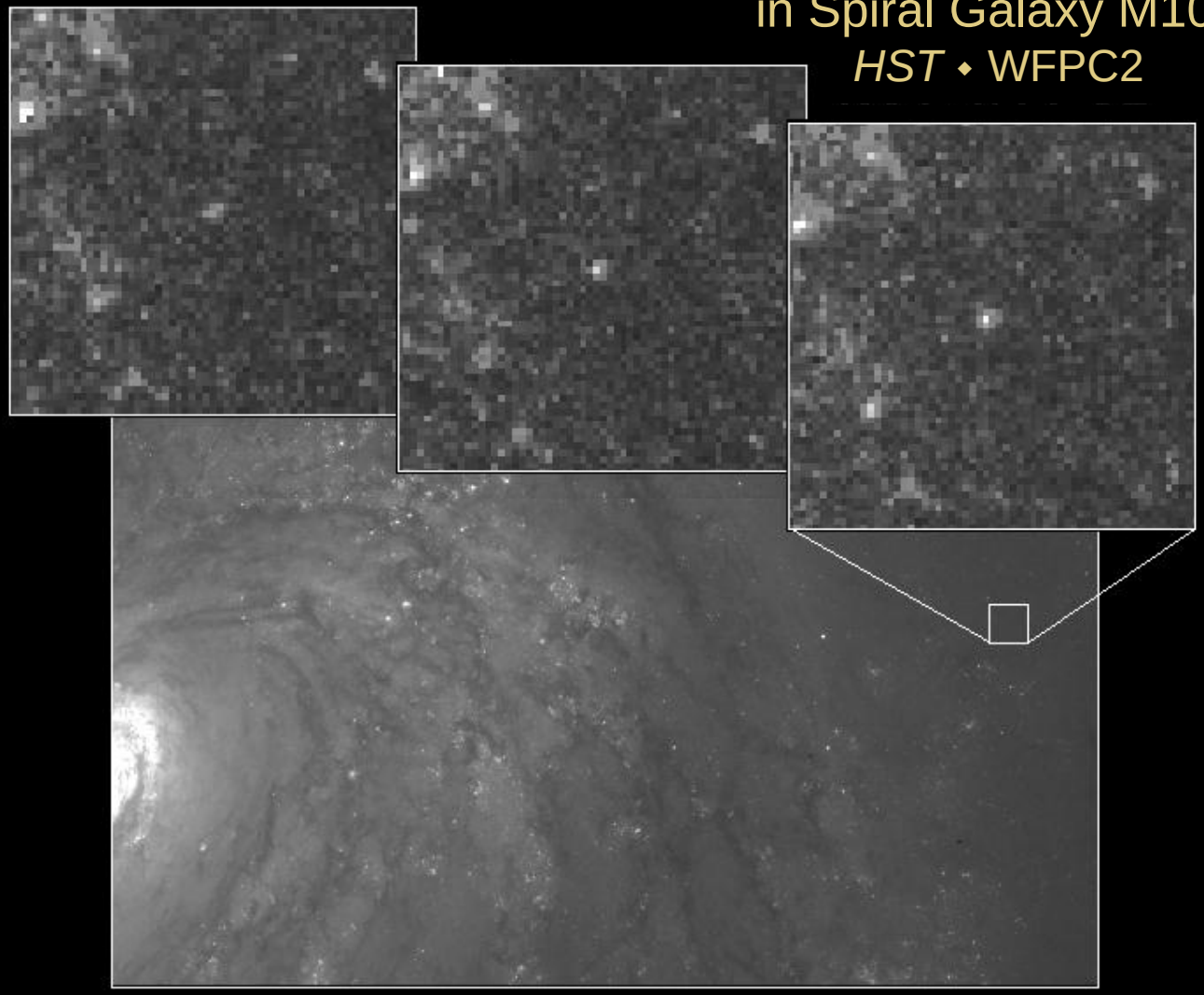

Present
Accelerating expansion
Slowing expansion
Farthest supernova
Big Bang
Time (~15 billion years)
Expanding universe

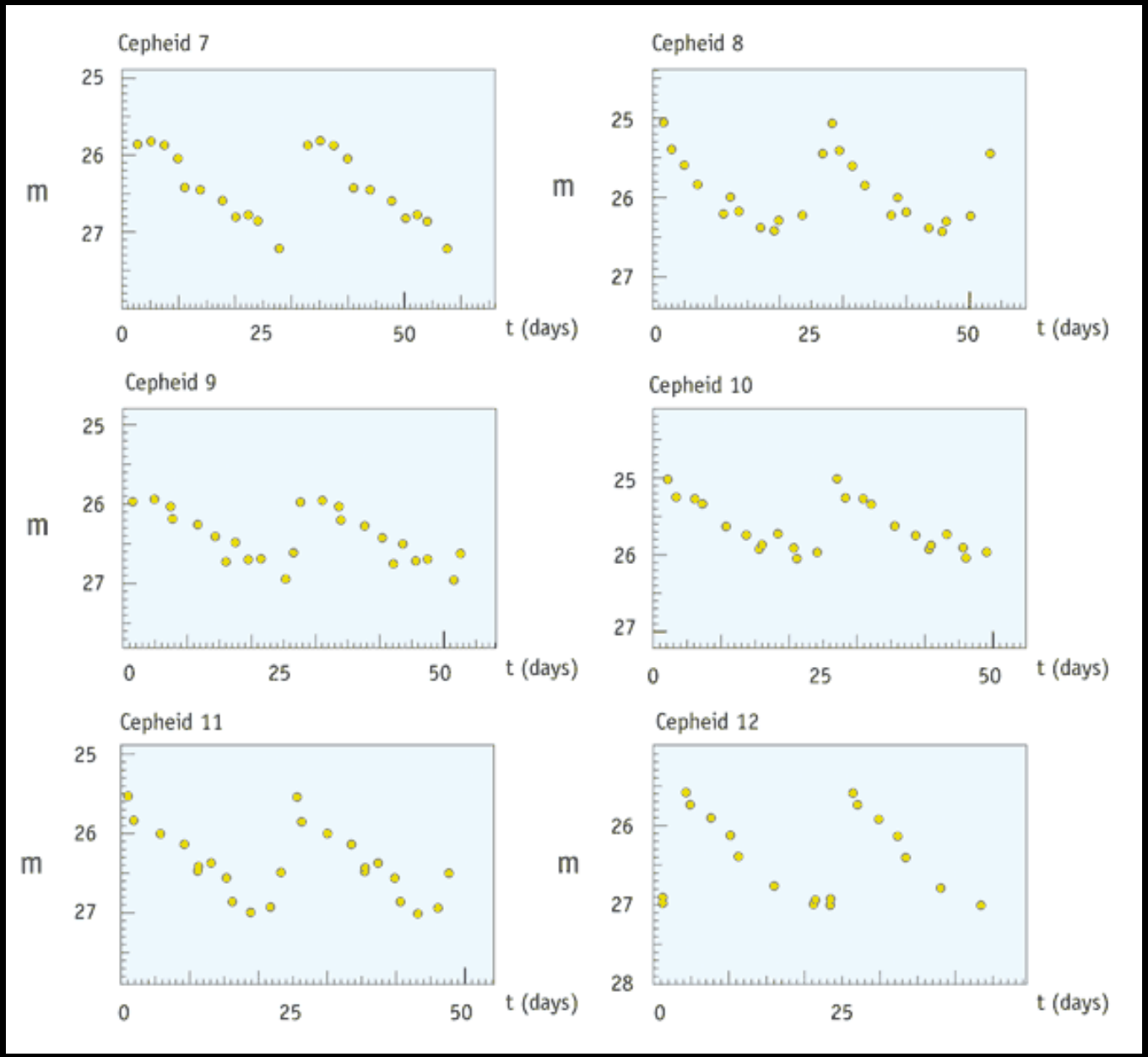

Composition of the Cosmos
Neutrinos: 0.6%
Baryons (atoms): comprising stars, heavy elements, and helium and free hydrogen: 4.4%
Dark matter: 22%
Dark energy: 73%

2: The Distance Scale and Age of the Universe

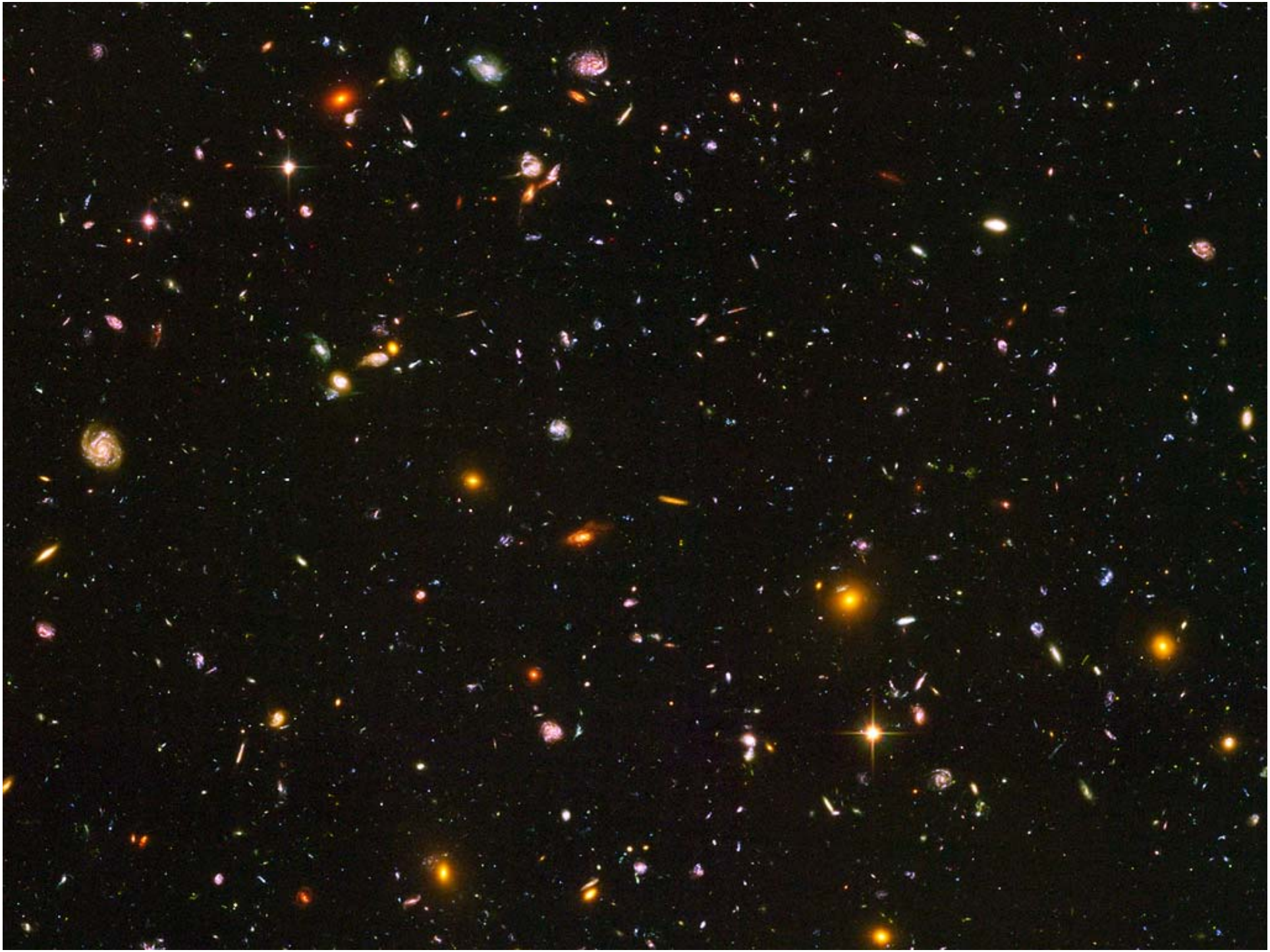


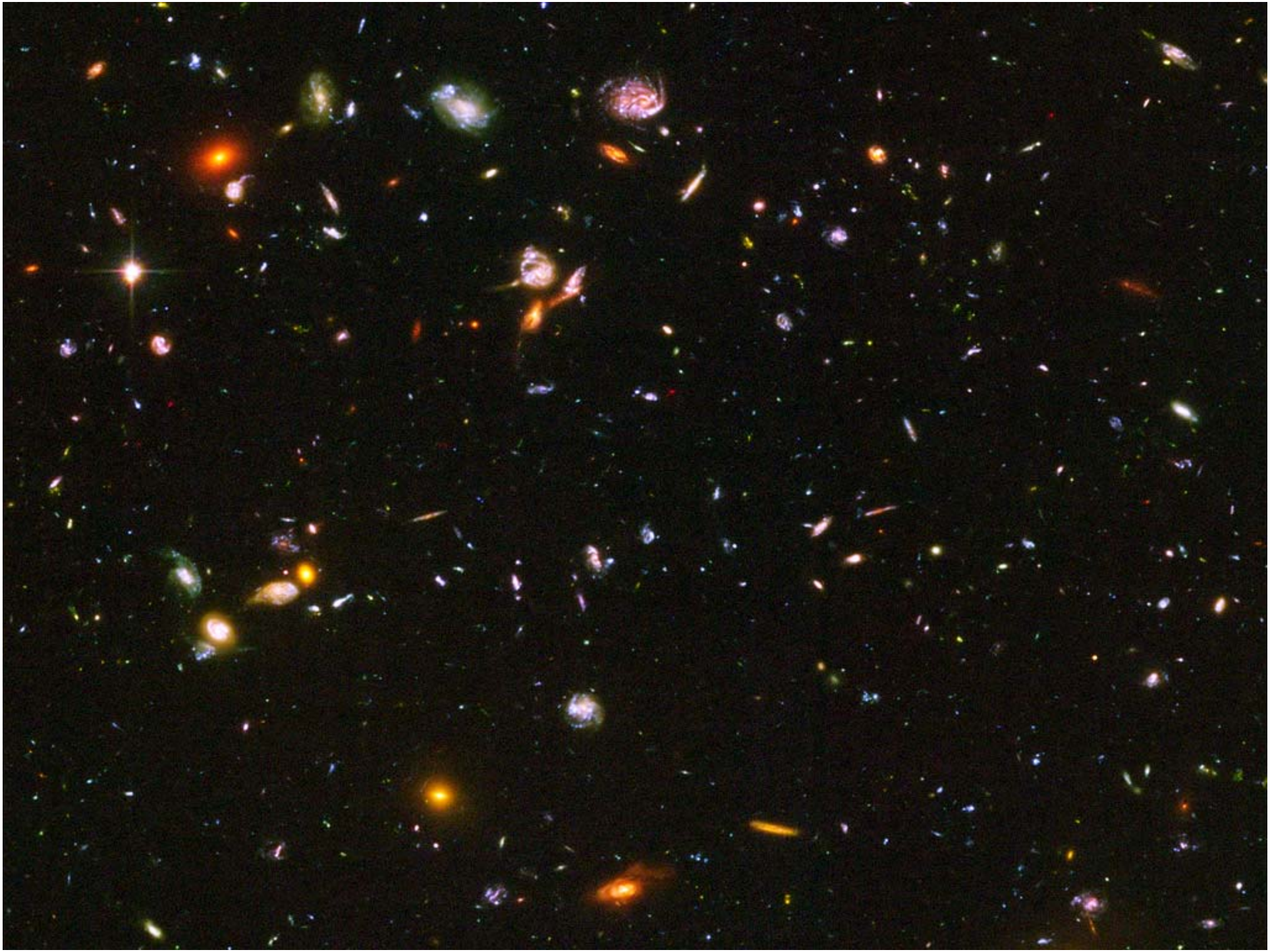
Cepheid Variable Star
in Spiral Galaxy M100
HST ◆ WFPC2

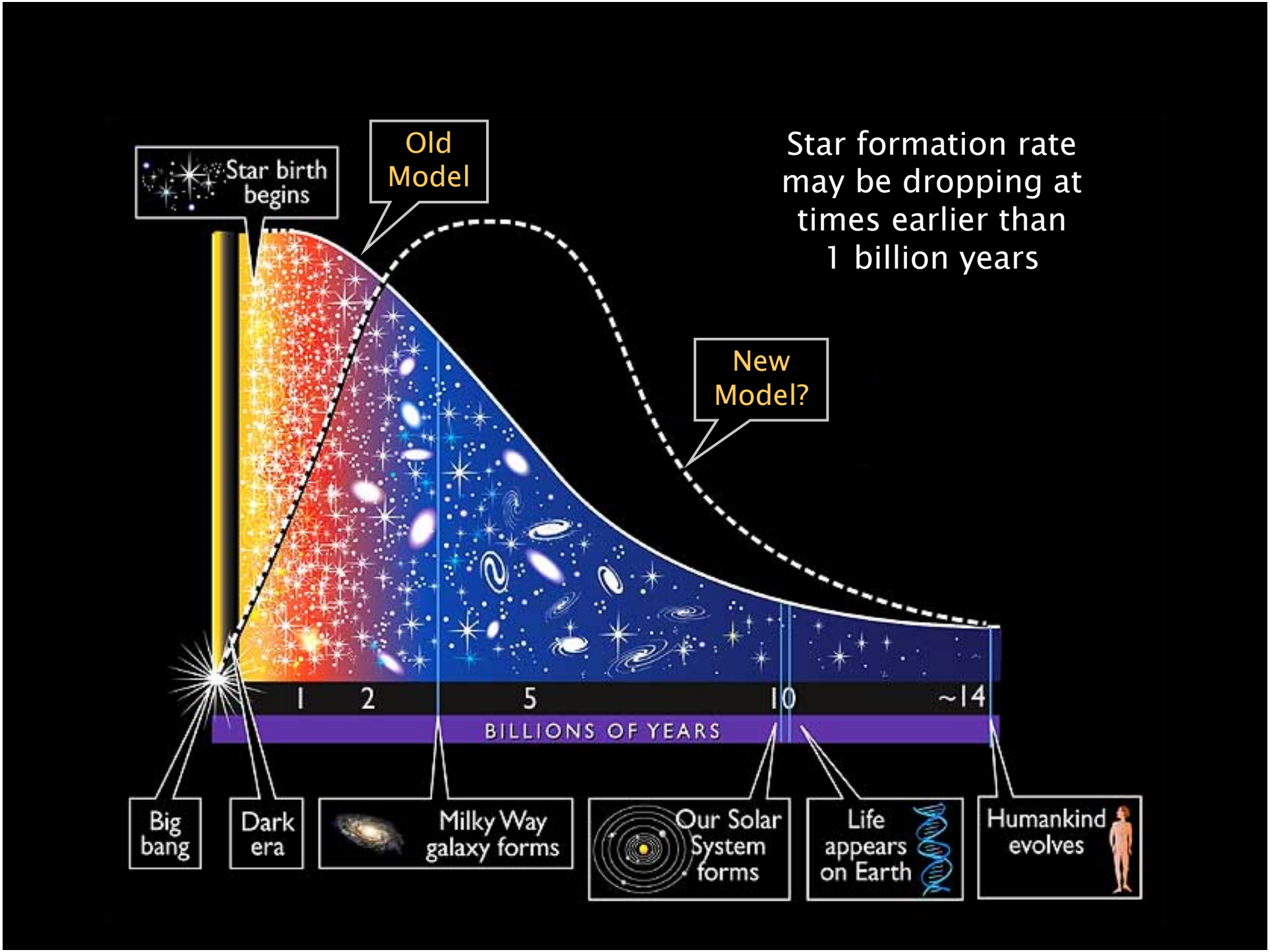



Cepheid 7
Cepheid 8
Cepheid 9
Cepheid 10
Cepheid 11
Cepheid 12
m
t (days)
0
25
50
25
26
27
28

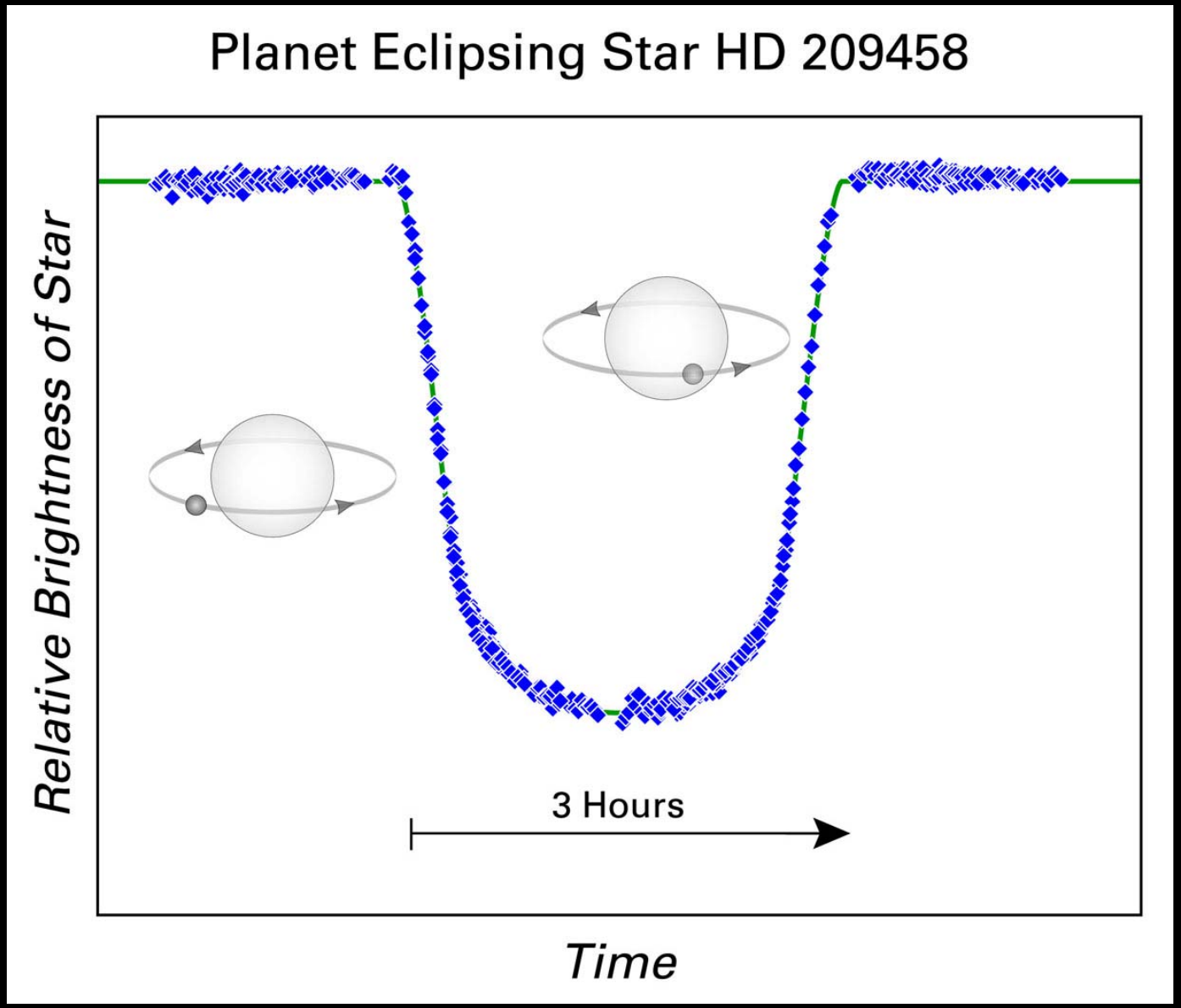
3: The Evolution of Galaxies and the Cosmic Star Formation Rate



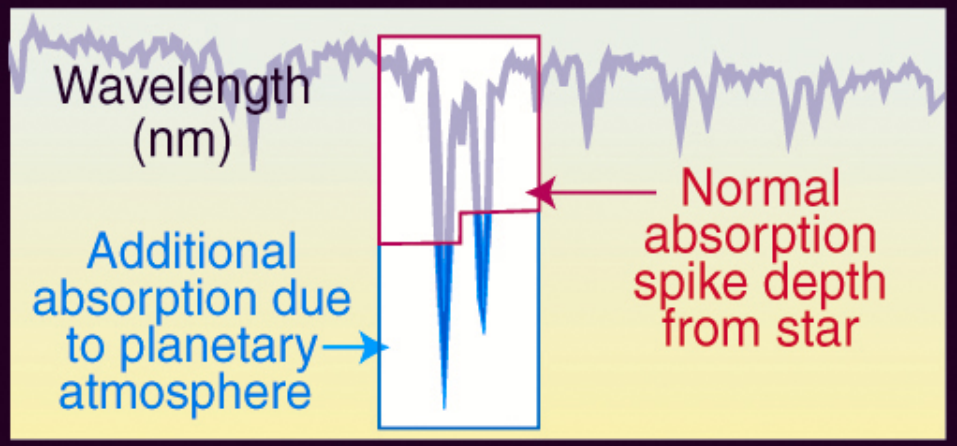


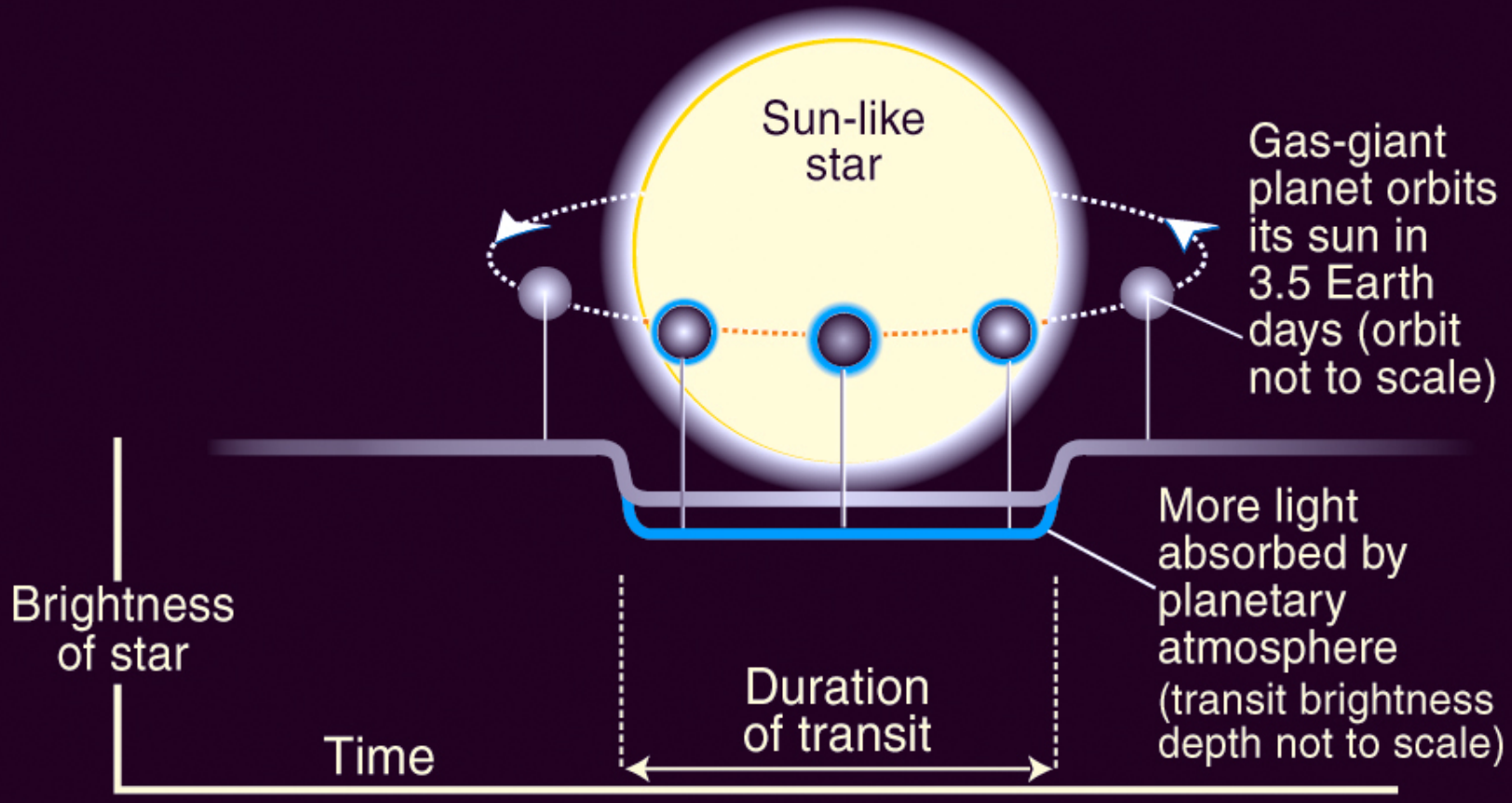

Star birth begins
Old Model
New Model?
Star formation rate may be dropping at times earlier than 1 billion years
1
2
5
10
~14
BILLIONS OF YEARS
Big bang
Dark era
Milky Way galaxy forms
Our Solar System forms
Life appears on Earth
Humankind evolves

4: Extrasolar Planets


Planet Eclipsing Star HD 209458
Relative Brightness of Star
3 Hours
Time

HST detects additional sodium absorption due to light passing through planetary atmosphere as planet transits across star





THE NEW YORK TIMES **EDITORIALS/LETTERS** FRIDAY, MAY 3, 2002

The Hubble Achievement

It seems hard to believe that we have already grown used to seeing images from the Hubble Space Telescope in the dozen years since it was first launched. But the startling pictures released this week from a newly restored Hubble are a reminder that we had, in fact, begun to take for granted our ability to peer into deep space, an ability no generation of humans has ever possessed before. In a sense, these new images, produced with cameras and power sources that were added or rejuvenated during a space shuttle flight in March, feel something like learning to see all over again. They

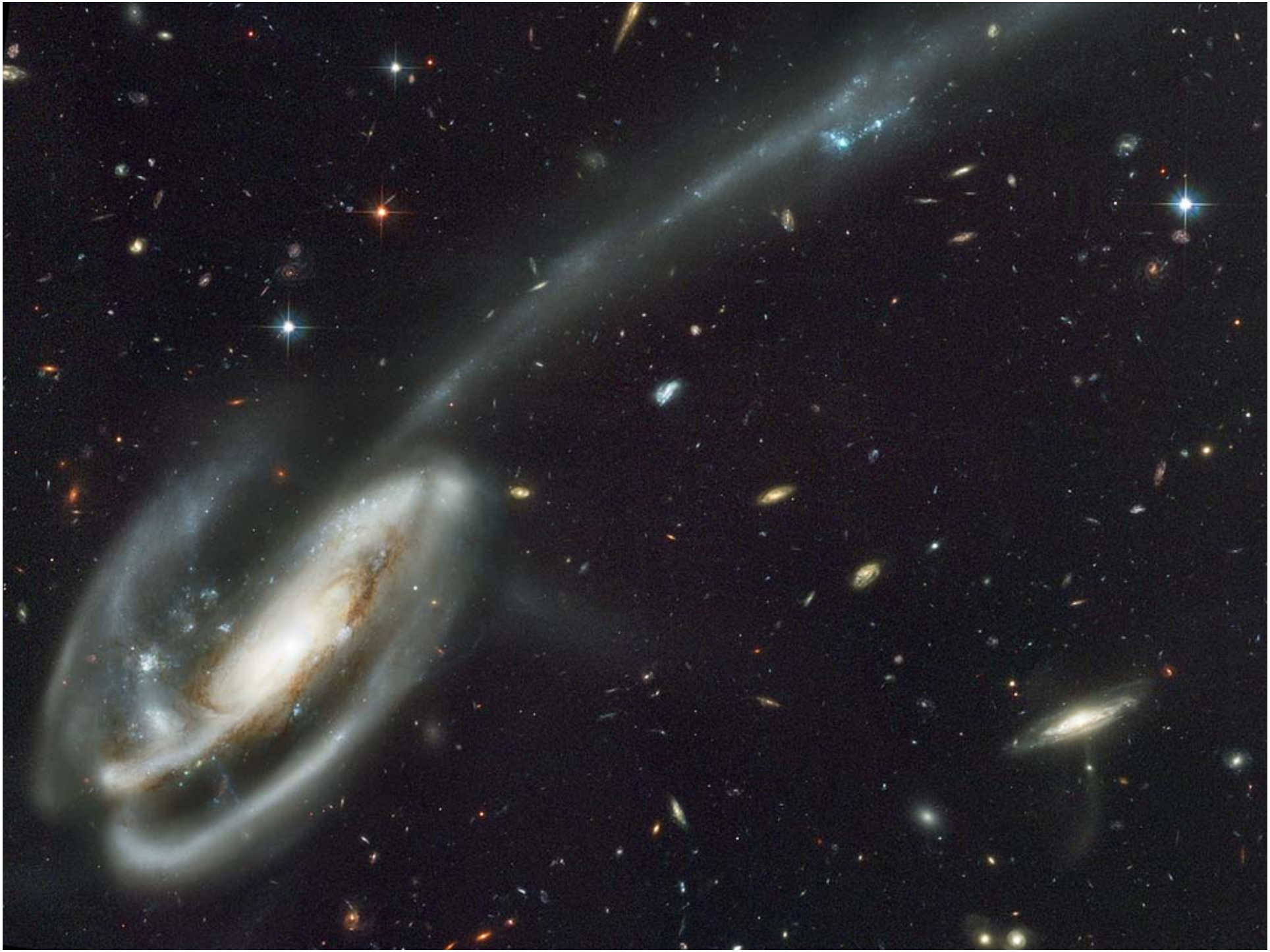
when you begin to realize what these forms are that

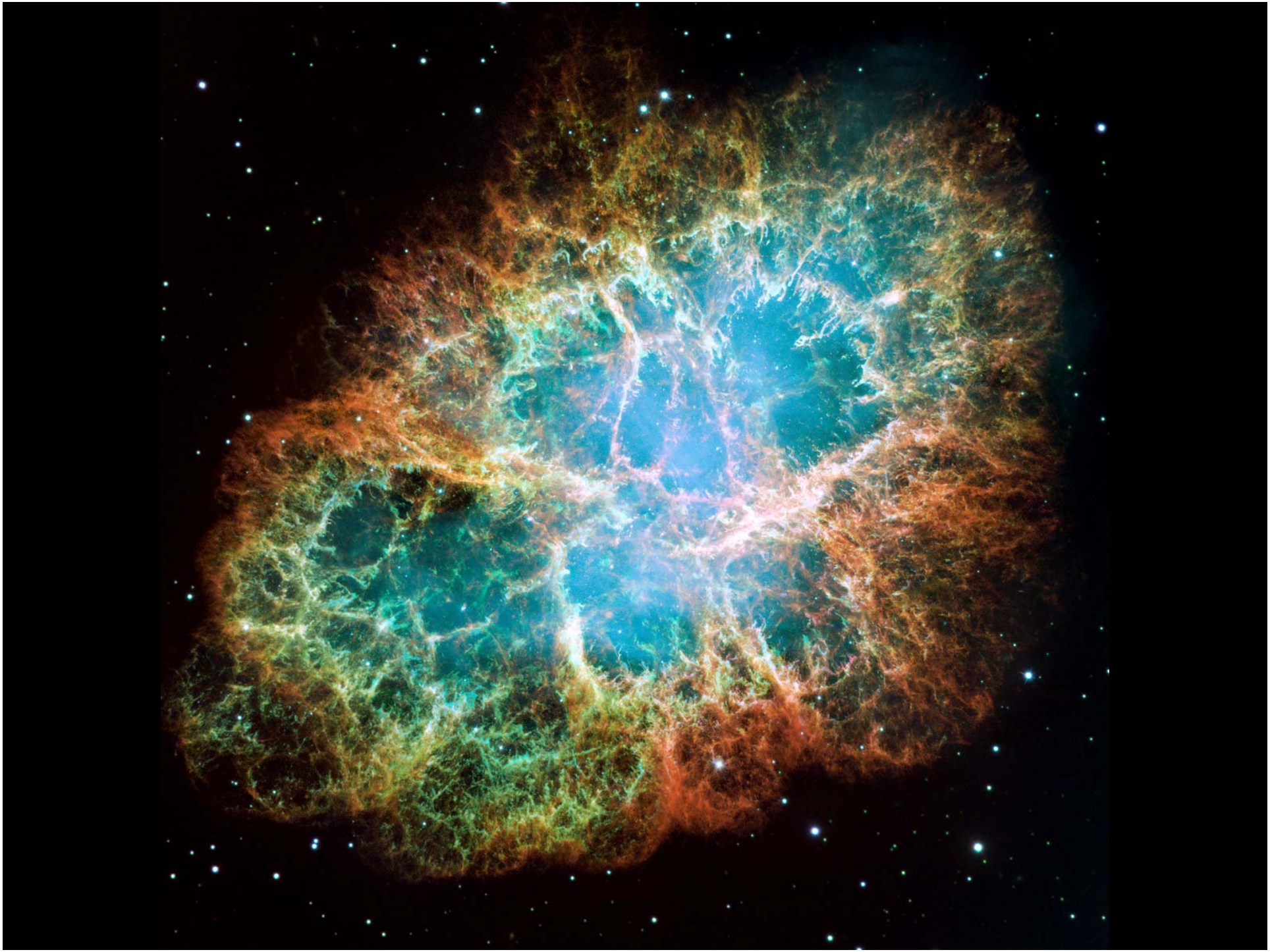
the real wonder appears. Beyond the uniformity of the naked-eye universe, there is this other universe, the one Hubble discovers with astonishing clarity. This is a place full of discordant objects, of cataclysmic disturbances. Galaxies devour each other. Stars form in infernos of gas and dust and light. And they do so against the backdrop of a sky that is almost unimaginably deep.

For what the Hubble cameras show us, especially in their new incarnation, is time itself. The distance of the distant objects in these images is measured as much by their relative youth, by how

with their thoughts.

It has taught us to see the properties of a universe humans have been able, for most of their history, to probe only with their thoughts.





To be continued…